OPEN ACCESS

# UEFA Women's Elite Club Injury Study: a prospective study on 1527 injuries over four consecutive seasons 2018/2019 to 2021/2022 reveals thigh muscle injuries to be most common and ACL injuries most burdensome

Anna Hallén [1,2] Rita Tomás,[3,4] Jan Ekstrand [1,5] Håkan Bengtsson [1,5] Elke Van den Steen,[6] Martin Hägglund [1,2] Markus Waldén [1,5]

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bjsports-2023-107133).

[1]Football Research Group, Linköping, Sweden
[2]Unit of Physiotherapy, Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden
[3]Federação Portuguesa de Futebol, Portugal Football School, Cruz Quebrada, Portugal
[4]PM&R Unit, Hospital CUF Descobertas, Lisboa, Portugal
[5]Unit of Public Health, Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden
[6]Department of Physical and Rehabilitation Medicine, AZ St Jan, Brugge, Belgium

**Correspondence to**
Anna Hallén, Unit of Physiotherapy, Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden; anna.a.hallen@liu.se

Accepted 13 December 2023
Published Online First 5 January 2024

## ABSTRACT

**Objective** Injuries in women's football (soccer) have scarcely been investigated, and no study has been conducted in the highest competitive level involving club teams from different countries. Our aim was to investigate the time-loss injury epidemiology and characteristics among women's elite football players over four seasons.

**Methods** 596 players from 15 elite women's teams in Europe were studied prospectively during the 2018/2019 to 2021/2022 seasons (44 team seasons). Medical staff recorded individual player exposure and time-loss injuries. Injury incidence was calculated as the number of injuries per 1000 playing hours and injury burden as the number of days lost per 1000 hours.

**Results** 1527 injuries were recorded in 463 players with an injury incidence of 6.7 (95% CI 6.4 to 7.0) injuries per 1000 hours and a nearly fourfold higher incidence during match play compared with training (18.4, 95% CI 16.9 to 19.9 vs 4.8, 95% CI 4.5 to 5.1; rate ratio 3.8, 95% CI 3.5 to 4.2). Thigh muscle injuries (hamstrings 12%, 188/1527, and quadriceps 11%, 171/1527) were the most frequent injury, while anterior cruciate ligament (ACL) injury had the highest burden (38.0 days lost per 1000 hours, IQR 29.2–52.1) with median days lost of 292 (IQR 246–334) days. Concussions constituted 3% (47/1527) of all injuries, with more than half of them (55%, 26/47) due to ball-related impact.

**Conclusion** An elite women's football team can expect approximately 35 time-loss injuries per season. Thigh muscle injury was the most common injury and ACL injury had the highest injury burden.

### WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Injuries in women's football have scarcely been investigated, and no study has been carried out at the highest competitive level involving club teams from different countries followed across several seasons.

### WHAT THIS STUDY ADDS

⇒ An elite women's football team can expect 35 time-loss injuries per season (1.5 injuries per player) with a nearly fourfold higher incidence during match play compared with training.
⇒ Hamstring muscle injury was most frequent (12%), closely followed by quadriceps muscle injury (11%).
⇒ Anterior cruciate ligament (ACL) injury was infrequent (2%) but had the highest injury burden.

### HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our study increases the knowledge and understanding of injury epidemiology among women's elite football players and opens opportunities for further substudies.
⇒ This study underlines the importance of implementing and evaluating preventive measures for frequent injuries such as thigh muscle injuries, and injuries with high burden and potentially negative long-term consequences such as ACL injury and concussion.

## INTRODUCTION

Nearly 1.4 million women were registered football players in Europe in 2017 according to the Union of European Football Associations (UEFA),[1] with around 3.600 of them being professional or semiprofessional. As concluded in several recent reviews,[2–7] women's football injuries have been scarcely investigated. Two of these reported very similar injury incidences for women's elite football as in men's elite football; 5.6–5.7 injuries per 1000 hours in total, 3.2–3.3 in training, and 19.1–19.5 in matches.[3 6] Additionally, most injuries were located at the knee, thigh and ankle, and the most frequent injury types were joint/ligament injuries, muscle injuries and contusions/haematomas.

Even if there are several studies on elite women's club teams,[8–17] no previous study has included teams from the highest competitive club level in different European countries, as has been a matter of routine for the past two decades in men's football.[18 19] In addition, most of the data collection in the previous studies on women's elite football took place more than a decade ago when a majority of players were not fully professional. Therefore, the aim of this study was to investigate the time-loss



**To cite:** Hallén A, Tomás R, Ekstrand J, *et al*. *Br J Sports Med* 2024;**58**:128–135.

injury epidemiology and characteristics among women professional football players in Europe during four consecutive seasons, 2018/2019 to 2021/2022.

## MATERIAL AND METHODS

Using the same design as for the UEFA Elite Club Injury Study (ECIS),[20] the UEFA Women's Elite Club Injury Study (WECIS) was launched in July 2018. The methodology adheres to the guidelines of the original consensus statement for football,[21] and mostly to the International Olympic Committee (IOC) consensus statement,[22] and where applicable, its recently published football consensus extension.[23]

### Study population

This study is ongoing with findings reported for the 2018/2019 to 2021/2022 seasons, including the 2020 lockdown due to the COVID-19 pandemic. In most European countries, the football season starts with a pre-season in July and the first half of August, followed by a competitive season from approximately the middle of August, ending in May. During 2019/2020, all major European first leagues cancelled the remaining matches (between four and eight matches left) from March 2020 due to the COVID-19 pandemic except for the German Frauen-Bundesliga which was temporarily paused and restarted in June 2020. All 2020/2021 league matches started as planned in the middle of August 2020. Conversely, the Swedish first league, Damallsvenskan, which has a spring to autumn season was postponed from the planned start in April to June 2020 and ended in late November with the 2021 season starting as usual in April. No league or cup matches were cancelled due COVID-19 during the second half of 2020 nor throughout the 2021 season.

Before commencing the study, forms and the data collection procedures were tested in a pilot study from January to May 2017/2018. A convenient sample of 12 teams selected by UEFA based on the UEFA league coefficient with champions and runners-up from associations 1–8 and champions from associations 9–12 being directly qualified to the Women's Champions League, and on the inclusion of their men's counterparts in the ECIS. All data from these months are excluded from this report as decided a priori because of expected incomplete data collection. Two pilot study teams did not deliver complete data from July 2018 and were excluded. Following inception, another five teams based on the same inclusion criteria were added resulting in six teams delivering complete four-season data, four teams complete three-season data, three teams complete two-season data and two teams complete one-season data (online supplemental table 1). Except for one team, all teams were ranked among the top five in the highest national leagues of Europe.

All first team squad players (most being professionals, some being amateurs) were informed about the study by their team physician at the start of pre-season, or when joining the team later during the season, and provided written consent. Players who left during the season for a team outside the WECIS were included for their entire time of participation.

### Study procedure

All teams were requested to appoint a contact person in the club medical staff at each season start, usually the team physician, to inform the players about the study and to be responsible for the data collection. To ensure that the study methodology was followed, each contact person was provided with a study manual containing all operational definitions and other relevant information of the data collection procedure with practical examples as well as the three study forms. All football exposure and injuries that occurred during team activities were recorded on standard forms which were sent to the study group each month. The first author reviewed the reported data and, if there were any missing non-optional or unclear data, immediate feedback was sent back to the contact person to enable corrections of the reports.

### Exposure and injury registration

Baseline data regarding anthropometrics and leg dominance were collected at player inclusion. Training and match exposure (in minutes) with the club and the national team was registered for each player on an attendance record. All football-related injuries were noted on a one-page injury card with compulsory tick-box alternatives on type of training/match, injury type/location, injury mechanism, and so on, and an optional free text on diagnosis and further information such as specified muscle, tendon or ligament involvement. Injuries were classified into different severity categories (table 1), and tabulated according to the recommendations in the recent football-specific consensus extension.[23]

### Patient involvement

This research was done without patient (player) involvement. Patients were not invited to comment on the study design or to contribute to the writing of the article.

### Equity, diversity and inclusion

This study was conducted on women's elite football players exclusively. All teams included were from high-income countries with no representation from middle-income or low-income countries. There are four men and three women in the author list with varying nationalities, professions and fields of expertise.

### Statistical analysis

Only full season data were included in the analyses meaning that teams who delivered incomplete data or data for part of a season were excluded for that season. Continuous data for anthropometrics and exposures are presented as mean with SD. Injury incidence was calculated as the number of injuries per 1000 hours, as described in table 1, with 95% CI. Injury incidences were compared as a rate ratio (RR) with 95% CI using Poisson regression with number of injuries as the dependent variable and including exposure hours as offset. Injuries were also expressed as the average number of injuries per a typical 23-player squad team per season. Days lost were presented as median with IQR. Injury burden was defined as the number of days lost per 1000 hours, as described in table 1,[23 24] and is expressed as median with IQR. Differences in injury proportions between training and match play was analysed using the $\chi^2$ test. All analyses were two-sided and the significance level was set at $p<0.05$. All analyses were carried out in line with the checklist for statistical assessment of medical papers (CHAMP) statement,[25] using SPSS (IBM SPSS Statistics for Windows, V.27.0. Armonk, NY USA: IBM Corp). A statistical significance level of $p<0.05$ was applied.

## RESULTS

There were 596 unique players with a mean team squad size of 23 (SD 3.2) players. Mean player age was 23 (SD 4.4) years, height 169 (SD 6.3) cm and body mass 62 (SD 6.5) kg.

**Table 1** Operational definitions

| | |
|---|---|
| Exposure | Training or match with the club's first and reserve teams and any national team |
| Training | Scheduled physical training activity under the guidance of the coaching team |
| Match | Competitive or friendly match against another team |
| Training attendance | Players' active and full participation in scheduled team training |
| Match availability | Players' availability for match play regardless of being picked by the coach |
| Injury | Any physical complaint sustained by a player that resulted from a football match or football training and led to the player being unable to take full part in future football training or match play (time-loss injury) |
| Traumatic onset injury | Injury with sudden onset and known cause |
| Gradual onset injury | Injury with insidious onset and no known trauma |
| Contact injury | Injuries due to contact with another player or an object |
| Injury incidence | Number of injuries per 1000 player hours ((Σ injuries/Σ hours)×1000) |
| Injury burden | Number of days lost per 1000 player hours ((Σ days lost/Σ hours)×1000) |
| Recurrent injury | Injury of the same type and at the same site as an index injury occurring previously during the same season |
| Early recurrence | Recurrent injury that occurs within 2 months after return to full participation from the index injury |
| Injury severity | Number of days from injury to medical clearance. A player was considered injured until the medical team allowed full participation in team training sessions and being available for match play |
| Slight | Injury that results in 0 days lost from training or match |
| Minimal | Injury that results in 1–3 days lost from training or match |
| Mild | Injury that results in 4–7 days lost from training or match |
| Moderate | Injury that results in 8–28 days lost from training or match |
| Severe | Injury that results in >28 days lost from training or match |

## Exposure and injuries

Detailed data on exposure, injury incidence and injury burden (season-by-season and overall) are presented in table 2. The overall exposure was 227 922 hours (195 945 training, 31 977 match) during 44 team seasons with 1129 player seasons. The mean training attendance was 77% (2.8) and the mean player availability for match selection 85% (2.5).

In total, 463 (78%) of the players incurred 1527 injuries which means that a typical 23-player squad could expect 35 injuries per season. The overall injury incidence was 6.7 (95% CI 6.4 to 7.0) injuries per 1000 hours with a fourfold higher incidence during match play than training (18.4, 95% CI 16.9 to 19.9 vs 4.8, 95% CI 4.5 to 5.1; RR 3.8, 95% CI 3.5 to 4.2, p<0.001). The training injury incidence during the 2018/2019 season was significantly lower than the 2020/2021 (RR 0.7, 95% CI 0.6 to 0.9, p=0.001) and 2021/2022 seasons (RR 0.7, 95% CI 0.6 to 0.8, p<0.001), whereas the 2019/2020 COVID-19 affected season had a significantly lower training injury incidence than only the 2021/2022 season (RR 0.8, 95% CI 0.7 to 1.0, p=0.029) (table 2). However, the 2019/2020 COVID-19 affected season had a significantly lower match injury incidence than all other seasons (2019/2020 vs 2018/2019, RR 0.7, 95% CI 0.6 to 1.0,

**Table 2** Team and player exposure data, injury incidence and injury burden during the 2018/2019 to 2021/2022 seasons

| | 2018/2019 | | 2019/2020 | | 2020/2021 | | 2021/2022 | | 2018/2019 to 2021/2022 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean (SD) | | Mean (SD) | | Mean (SD) | | Mean (SD) | | Mean (SD) | |
| Training sessions | | | | | | | | | | |
| No/team | 183.5 (24.2) | | 155.4 (35.7) | | 197.8 (27.3) | | 182.3 (27.0) | | 179.1 (32.3) | |
| No/player | 144.2 (50.3) | | 117.5 (47.5) | | 154.6 (57.2) | | 133.5 (51.9) | | 137.0 (53.6) | |
| Matches | | | | | | | | | | |
| No/team | 39.8 (6.0) | | 29.3 (4.9) | | 40.3 (7.5) | | 42.4 (6.3) | | 37.7 (8.0) | |
| No/player | 26.9 (14.2) | | 19.5 (11.2) | | 25.9 (15.2) | | 28.0 (15.6) | | 24.9 (14.5) | |
| Player exposure (hours) | | | | | | | | | | |
| Training | 182.5 (66.0) | | 153.1 (60.7) | | 203.4 (83.3) | | 157.6 (66.3) | | 173.6 (72.5) | |
| Matches | 31.8 (18.9) | | 22.4 (15.2) | | 28.7 (19.8) | | 31.1 (19.7) | | 28.3 (18.8) | |
| Total | 214.3 (79.8) | | 175.5 (70.6) | | 232.2 (94.4) | | 188.7 (78.8) | | 201.9 (84.2) | |
| | N | Incidence (95% CI) | N | Incidence (95% CI) | N | Incidence (95% CI) | N | Incidence (95% CI) | N | Incidence (95% CI) |
| Injury incidence | | | | | | | | | | |
| Training | 174 | 3.8 (3.3 to 4.5) | 208 | 4.5 (3.9 to 5.2) | 305 | 5.2 (4.7 to 5.8) | 253 | 5.5 (4.9 to 6.2) | 940 | 4.8 (4.5 to 5.1) |
| Matches | 151 | 19.2 (16.3 to 22.5) | 96 | 14.2 (11.6 to 17.3) | 165 | 19.9 (17.1 to 23.2) | 175 | 19.4 (16.7 to 22.5) | 587 | 18.4 (16.9 to 19.9) |
| Total | 323 | 6.1 (5.5 to 6.8) | 306 | 5.7 (5.1 to 6.4) | 470 | 7.0 (6.4 to 7.7) | 428 | 7.8 (7.1 to 8.6) | 1527 | 6.7 (6.4 to 7.0) |
| | Days | Median (IQR) | Days | Median (IQR) | Days | Median (IQR) | Days | Median (IQR) | Days | Median (IQR) |
| Injury burden | | | | | | | | | | |
| Training | 3500 | 76.6 (54.8–88.8) | 5783 | 71.4 (44.4–185.5) | 7302 | 137.2 (83.3–163.3) | 5923 | 152.6 (73.0–180.7) | 22 508 | 110.1 (88.3–138.2) |
| Matches | 3673 | 356.6 (270.8–687.4) | 4534 | 556.5 (204.3–978.5) | 5132 | 475.3 (434.4–923.4) | 4785 | 479.4 (385.2–768.9) | 18 124 | 537.3 (392.6–678.0) |
| Total | 7173 | 126.3 (104.3–162.2) | 10 317 | 174.9 (135.7–269.7) | 12 434 | 189.5 (141.0–259.9) | 10 708 | 183.4 (123.9–250.5) | 40 632 | 175.5 (132.3–198.9) |

Injury incidence is defined as the number of injuries per 1000 hours and injury burden is defined as the number of days lost per 1000 hours.

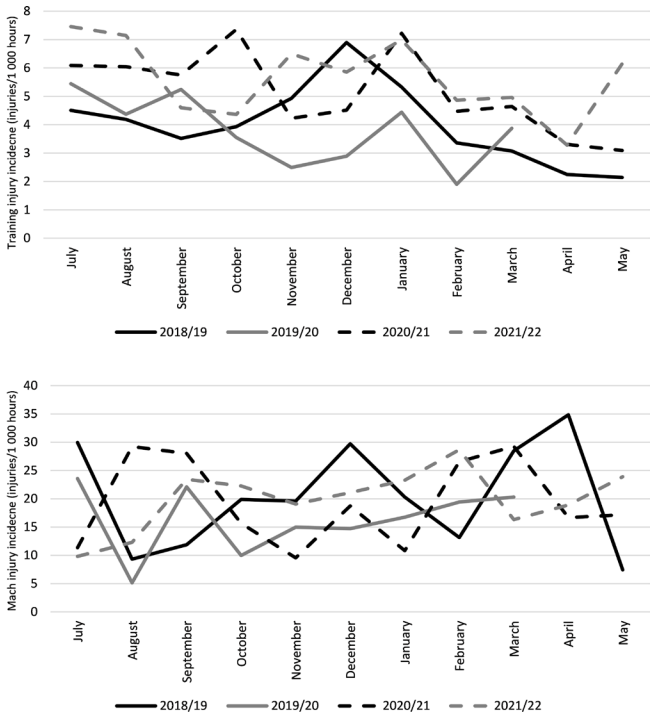


**Figure 1** Training and match injury incidences per month during the 2018/2019 to 2021/2022 seasons. Data from April to May 2020 were excluded due to negligible football exposures reported during the COVID-19 lockdown.

p=0.021; 2019/2020 vs 2020/21, RR 0.7, 95% CI 0.6 to 0.9, p=0.008; 2019/2020 vs 2021/2022 RR 0.7, 95% CI 0.6 to 0.9, p=0.014). The monthly distribution of training injury incidence was essentially similar for all seasons studied, while match injury incidences showed no similar clear trend (figure 1). The median injury burden was 176 days lost per 1000 hours, being fivefold higher during match play than training (p<0.001).

In total, 420 (70 %) of the players were called up for international duty at least once. National team play constituted 12% of the exposure (26 502 hours) and 8% of all reported injuries (55 training and 69 match). There were no differences in injury incidence between national team matches and club team matches (16.2, 95% CI 12.8 to 20.5 vs 18.4, 95% CI 16.9 to 19.9, RR, 0.9, 95% CI 0.7 to 1.1, p=0.333).

## Injury characteristics and injury mechanisms

Injury data for frequency, incidence and burden are seen in tables 3 and 4. In total, 1304 (85%) of the injuries were in the lower extremities with the thigh, knee and ankle being most frequent. There were 598 muscle injuries (39% of all injuries) and 304 ligament injuries (20% of all injuries).

In all, 53% (802/1523) of the injuries were of acute onset, while 47% (721/1523) had a gradual onset (injury onset missing for four injuries). Traumatic injuries were more common during match play compared with training (63%, 366/584 *vs* 46% 436/939, p<0.001). Contact injuries accounted for 28% (424/1525) of all injuries and represented a higher percentage for match injuries compared with training injuries (40%, 232/586 vs 20%, 192/939, p<0.001).

## Injury severity

Injury severity data are displayed in table 5 and in online supplemental table 2. Severe injuries constituted more than one-fifth of all injuries (21%, 321/1527) which means that the typical 23-player squad could expect seven severe injuries per season. Anterior cruciate ligament (ACL) injury 10% (33/321), quadriceps muscle injury 9% (28/321), and hamstring muscle injury 8% (25/321) were the three most common severe injury diagnoses. The severe injury incidence was fourfold higher during match play than training (4.1, 95% CI 3.4 to 4.8 vs 1.0, 95% CI 0.8 to 1.1; RR 4.2, 95% CI 3.3 to 5.2 p<0.001).

## Thigh muscle injuries

Hamstring muscle injury was the most frequent injury representing 12% (188/1527) of all injuries. The typical 23-player squad could thus expect four hamstring muscle injuries per season. The total hamstring muscle injury incidence was 0.8 (95% CI 0.7 to 1.0) injuries per 1000 hours and being fivefold higher during match play compared with training (table 3). The median days lost was 8 (IQR 4–16) days and the median injury burden was 8.3 (IQR 5.9–16.1) days lost per 1000 hours, being 12-fold higher during match play compared with training (table 4). The most frequent injury mechanism was running/sprinting (56%, 104/187, injury mechanism missing for one injury). In all, 125 injuries had optional free-text diagnoses to distinguish between biceps femoris and semimembranosus/semitendinosus; a majority of these (66%, 82/125) were located to the biceps femoris. Every sixth hamstring muscle injury was a recurrence (17%, 32/188) with 26 (81%) being early recurrences.

Quadriceps muscle injury was almost as frequent as hamstring muscle injury representing 11% (171/1527) of all injuries. The typical 23-player squad could thus expect approximately four quadriceps muscle injuries per season. The total quadriceps muscle injury incidence was 0.8 (95% CI 0.6 to 0.9) injuries per 1000 hours and being almost threefold higher during match play compared with training (table 3). The median days lost was 9 (IQR 4–22) days and the median injury burden was 10.1 (IQR 4.8–18.6) days lost per 1000 hours, being fourfold higher during match play compared with training (table 4). The most frequent injury mechanism was running/sprinting with 30% (52/171) of injuries, followed by shooting 23% (40/171). In all, 114 injuries (67%) had optional free-text diagnosis specific to the rectus femoris and the rest were unspecified. Every tenth quadriceps muscle injury was a recurrence (11%, 18/171) with 12 (67%) being early recurrences.

## Ankle and knee ligament injuries

Lateral ankle ligament injury was the most frequent ligament injury representing 7% (111/1527) of all injuries. The typical 23-player squad could thus expect 2.5 lateral ankle sprains per season. The total lateral ankle ligament injury incidence was 0.5 (95% CI 0.4 to 0.6) injuries per 1000 hours and being fourfold higher during match play compared with training (table 3). The median days lost was 9 (IQR 5–21) days and the median injury burden was 7.9 (IQR 4.1–13.1) days lost per 1000 hours, being threefold higher during match play compared with training (table 4). More than half of the lateral ankle ligament injuries had a contact mechanism (52%, 58/111). The main mechanisms of contact-related lateral ankle ligament injuries were being tackled (29%, 17/58) and jumping/landing (17%, 10/58). For non-contact lateral ankle ligament injuries, twisting/turning (32%, 17/53) and jumping/landing (26%, 14/53) were the two dominating mechanisms. Every tenth lateral ankle ligament injury was a recurrence (11%, 12/111) with seven being early recurrences.

**Table 3** Injury characteristics and incidence rate ratios between match play and training for all four seasons (2018/2019 to 2021/2022)

| | Total | | Training | | Match play | | | |
|---|---|---|---|---|---|---|---|---|
| Injury | N (%) | Incidence (95% CI) | N (%) | Incidence (95% CI) | N (%) | Incidence (95% CI) | Rate ratio (95% CI) | P value |
| Head/face | 60 (4) | 0.3 (0.2 to 0.3) | 35 (4) | 0.2 (0.1 to 0.2) | 25 (4) | 0.8 (0.5 to 1.2) | 4.4 (2.6 to 7.3) | <0.001 |
| Concussion | 47 (3) | 0.2 (0.2 to 0.3) | 29 (3) | 0.1 (0.1 to 0.2) | 18 (3) | 0.6 (0.4 to 0.9) | 3.8 (2.1 to 6.8) | <0.001 |
| Neck/cervical spine | 11 (<1) | 0.0 (0.0 to 0.1) | 8 (<1) | 0.0 (0.0 to 0.1) | 3 (<1) | 0.1 (0.0 to 0.3) | 2.3 (0.6 to 8.7) | 0.219 |
| Shoulder/clavicle | 24 (2) | 0.1 (0.1 to 0.2) | 12 (1) | 0.1 (0.0 to 0.1) | 12 (2) | 0.4 (0.2 to 0.7) | 6.1 (2.8 to 13.6) | <0.001 |
| Arm/hand | 37 (2) | 0.2 (0.1 to 0.2) | 24 (3) | 0.1 (0.1 to 0.2) | 13 (2) | 0.4 (0.2 to 0.7) | 3.3 (1.7 to 6.5) | <0.001 |
| Sternum/upper back | 8 (<1) | 0.0 (0.0 to 0.1) | 3 (<1) | 0.0 (0.0 to 0.0) | 5 (<1) | 0.2 (0.1 to 0.4) | 10.2 (2.4 to 42.7) | 0.001 |
| Abdomen | 7 (<1) | 0.0 (0.0 to 0.1) | 7 (<1) | 0.0 (0.0 to 0.1) | – | – | – | – |
| Lower back/pelvis/ sacrum | 76 (5) | 0.3 (0.3 to 0.4) | 61 (6) | 0.3 (0.2 to 0.4) | 15 (3) | 0.5 (0.3 to 0.8) | 1.5 (0.9 to 2.7) | 0.155 |
| Hip/groin | 151 (10) | 0.7 (0.6 to 0.8) | 99 (11) | 0.5 (0.4 to 0.6) | 52 (9) | 1.6 (1.2 to 2.1) | 3.2 (2.3 to 4.5) | <0.001 |
| Muscle injuries | 104 (7) | 0.5 (0.4 to 0.6) | 67 (7) | 0.3 (0.3 to 0.4) | 37 (6) | 1.2 (0.8 to 1.6) | 3.4 (2.3 to 5.1) | <0.001 |
| Adductor | 66 (4) | 0.3 (0.2 to 0.4) | 46 (5) | 0.2 (0.2 to 0.3) | 20 (3) | 0.6 (0.4 to 1.0) | 2.7 (1.6 to 4.5) | <0.001 |
| Thigh | 408 (27) | 1.8 (1.6 to 2.0) | 245 (26) | 1.3 (1.1 to 1.4) | 163 (28) | 5.1 (4.4 to 5.9) | 4.1 (3.3 to 5.0) | <0.001 |
| Muscle injuries | 361 (24) | 1.6 (1.4 to 1.8) | 222 (24) | 1.1 (1.0 to 1.3) | 139 (24) | 4.3 (3.7 to 5.1) | 3.8 (3.1 to 4.7) | <0.001 |
| Quadriceps | 171 (11) | 0.8 (0.6 to 0.9) | 120 (13) | 0.6 (0.5 to 0.7) | 51 (9) | 1.6 (1.2 to 2.1) | 2.6 (1.9 to 3.6) | <0.001 |
| Hamstrings | 188 (12) | 0.8 (0.7 to 1.0) | 101 (11) | 0.5 (0.4 to 0.6) | 87 (15) | 2.7 (2.2 to 3.4) | 5.3 (4.0 to 7.0) | <0.001 |
| Knee | 270 (18) | 1.2 (1.1 to 1.3) | 159 (17) | 0.8 (0.7 to 0.9) | 111 (19) | 3.5 (2.9 to 4.2) | 4.3 (3.4 to 5.5) | <0.001 |
| Ligament injuries | 107 (7) | 0.5 (0.4 to 0.6) | 50 (5) | 0.3 (0.2 to 0.3) | 57 (10) | 1.8 (1.4 to 2.3) | 7.0 (4.8 to 10.2) | <0.001 |
| Medial collateral | 43 (3) | 0.2 (0.1 to 0.3) | 20 (2) | 0.1 (0.1 to 0.2) | 23 (4) | 0.7 (0.5 to 1.1) | 7.0 (3.9 to 12.8) | <0.001 |
| Anterior cruciate | 33 (2) | 0.1 (0.1 to 0.2) | 13 (1) | 0.1 (0.0 to 0.1) | 20 (3) | 0.6 (0.4 to 1.0) | 9.4 (4.7 to 19.0) | <0.001 |
| Meniscus/cartilage injuries | 56 (4) | 0.2 (0.2 to 0.3) | 44 (5) | 0.2 (0.2 to 0.3) | 12 (2) | 0.4 (0.2 to 0.7) | 1.7 (0.9 to 3.2) | 0.115 |
| Lower leg/Achilles tendon | 175 (11) | 0.8 (0.7 to 0.9) | 119 (13) | 0.6 (0.5 to 0.7) | 56 (10) | 1.8 (1.3 to 2.3) | 2.9 (2.1 to 4.0) | <0.001 |
| Muscle injuries | 91 (6) | 0.4 (0.3 to 0.5) | 61 (6) | 0.3 (0.2 to 0.4) | 30 (5) | 0.9 (0.7 to 1.3) | 3.0 (1.9 to 4.7) | <0.001 |
| Achilles tendon injuries | 43 (3) | 0.2 (0.1 to 0.3) | 31 (3) | 0.2 (0.1 to 0.2) | 12 (2) | 0.4 (0.2 to 0.7) | 2.4 (1.2 to 4.6) | 0.011 |
| Ankle | 209 (14) | 0.9 (0.8 to 1.1) | 112 (12) | 0.6 (0.5 to 0.7) | 97 (17) | 3.0 (2.5 to 3.7) | 5.3 (4.0 to 7.0) | <0.001 |
| Ligament injuries | 156 (10) | 0.7 (0.6 to 0.8) | 90 (10) | 0.5 (0.4 to 0.6) | 66 (11) | 2.1 (1.6 to 2.6) | 4.5 (3.3 to 6.2) | <0.001 |
| Lateral ligaments | 111 (7) | 0.5 (0.4 to 0.6) | 68 (7) | 0.3 (0.3 to 0.4) | 43 (7) | 1.3 (1.0 to 1.8) | 3.9 (2.6 to 5.7) | <0.001 |
| Foot/toe | 91 (6) | 0.4 (0.3 to 0.5) | 56 (6) | 0.3 (0.2 to 0.4) | 35 (6) | 1.1 (0.8 to 1.5) | 3.8 (2.5 to 5.8) | <0.001 |

Injury incidence is defined as the number of injuries per 1000 hours.

Medial collateral ligament (MCL) injury of the knee was the second most frequent ligament injury representing 3% (43/1527) of all injuries. The typical 23-player squad could thus expect one MCL injury per season. The total MCL injury incidence was 0.2 (95% CI 0.1 to 0.3) injuries per 1000 hours and being sevenfold higher during match play compared with training (table 3). The median days lost was 14 (IQR 7–34) days and the median injury burden was 4.1 (IQR 0.7–8.6) days lost per 1000 hours, being almost 12-fold higher during match play compared with training (table 4). Significantly more MCL injuries had a contact rather than a non-contact injury mechanism (72%, 31/43 vs 28%, 12/43, p<0.004). The main mechanisms of contact-related MCL injuries were being tackled (26%, 8/31) and twisting/turning (16% 5/31). Every 14th MCL injury was a recurrence (7%, 3/43) with all three being early recurrences.

ACL injury was almost as frequent as MCL injury with 33 injuries in 30 players from 11 clubs (online supplemental table 3). It was the second most frequent knee ligament injury representing 2% (33/1527) of all injuries. The typical 23-player squad could thus expect approximately 0.7 ACL injuries per season. The total ACL injury incidence was 0.1 (95% CI 0.1 to 0.2) injuries per 1000 hours and being ninefold higher during match play compared with training (table 3). All ACL injuries except one were diagnosed as total ruptures and all total ruptures were treated with ACL reconstruction (online supplemental table 3). The median days lost, including the partial rupture, was 292 (IQR 246–334) days and the median injury burden was 38.0 (IQR 29.2–52.1) days lost per 1000 hours, being sixfold higher during match play compared with training (table 4). One player with a total ACL injury ended their career, otherwise one player returned to full team training within 6 months (3%), 13 (41%) within 9 months, and 30 (94%) within 12 months. Most ACL injuries had a non-contact mechanism (64%, 21/33). The two dominating injury mechanisms for non-contact ACL injuries were twisting/turning (48%, 10/21) and jumping/landing (24%, 5/21). Being tackled (42%, 5/12) was the main injury mechanism for contact-related ACL injuries.

## Concussions

Concussion was the most frequent head injury representing 3% (47/1527) of all injuries. The typical 23-player squad could thus expect one concussion per season. The total concussion incidence was 0.2 (95% CI 0.2 to 0.3) injuries per 1000 hours and being fourfold higher during match play compared with training (table 3). The median days lost was 9 (IQR 6–19) days and the median injury burden was 0.8 (IQR 0–3.9) days lost per 1000 hours, being sevenfold higher during match play compared with training (table 4). In more than one-quarter of cases (28%, 13/47), the player returned to full team training within 6 days. The two main mechanisms of concussion were being hit by a ball (34%, 16/47) and heading the ball (21%, 10/47). Half of all match-related concussions (50%, 9/18) occurred due to heading the ball, while being hit by the ball was the most frequent injury

**Table 4** Injury burden for all four seasons (2018/2019 to 2021/2022)

| | Total | Training | Match play |
|---|---|---|---|
| Injury | Burden (IQR) | Burden (IQR) | Burden (IQR) |
| Head/face | 0.9 (0.8 to 3.9) | 1.0 (0.0 to 3.2) | 5.0 (0.0 to 16.9) |
| Concussion | 0.8 (0.0 to 3.9) | 0.5 (0.0 to 3.2) | 3.6 (0.0 to 16.9) |
| Neck/cervical spine | 0.0 (0.0 to 0.3) | 0.0 (0.0 to 0.4) | 0.0 (0.0 to 0.0) |
| Shoulder/clavicle | 1.7 (0.5 to 4.6) | 0.8 (0.0 to 2.7) | 0.0 (0.0 to 17.1) |
| Arm/hand | 7.5 (2.1 to 11.3) | 4.4 (1.4 to 6.6) | 24.2 (5.0 to 49.0) |
| Sternum/upper back | 0.0 (0.0 to 0.1) | 0.0 (0.0 to 0.0) | 0.0 (0.0 to 0.6) |
| Abdomen | 0.0 (0.0 to 0.3) | 0.0 (0.0 to 0.3) | – |
| Lower back/pelvis/ sacrum | 2.3 (1.7 to 4.9) | 1.9 (0.2 to 4.2) | 2.2 (0.0 to 10.9) |
| Hip/groin | 7.3 (2.5 to 14.0) | 5.2 (1.7 to 11.1) | 21.0 (0.0 to 26.2) |
| Muscle injuries | 4.2 (1.5 to 4.8) | 2.7 (0.6 to 5.5) | 11.4 (0.0 to 14.6) |
| Adductor | 3.0 (1.2 to 4.2) | 1.8 (0.4 to 4.0) | 4.2 (0.0 to 14.3) |
| Thigh | 25.3 (14.3 to 29.0) | 15.6 (7.5 to 23.9) | 93.1 (45.9 to 118.9) |
| Muscle injuries | 23.4 (12.8 to 27.2) | 14.8 (6.9 to 16.8) | 76.4 (45.9 to 110.3) |
| Quadriceps | 10.1 (4.8 to 18.7) | 6.0 (3.7 to 12.1) | 25.2 (3.0 to 54.0) |
| Hamstrings | 8.3 (5.9 to 16.1) | 4.1 (1.7 to 7.2) | 47.6 (26.8 to 59.5) |
| Knee | 84.5 (53.6 to 101.5) | 44.3 (24.6 to 71.2) | 266.9 (160.9 to 329.9) |
| Ligament injuries | 41.7 (39.2 to 68.9) | 19.1 (1.4 to 37.0) | 199.7 (103.5 to 297.6) |
| Medial collateral | 4.1 (0.7 to 8.6) | 0.9 (0.0 to 3.3) | 10.6 (4.5 to 64.6) |
| Anterior cruciate | 38.0 (29.2 to 52.1) | 18.5 (0.0 to 34.0) | 117.0 (0.0 to 281.4) |
| Meniscus/cartilage injuries | 15.6 (1.8 to 27.4) | 15.0 (0.5 to 30.9) | 3.6 (0.0 to 21.2) |
| Lower leg/Achilles tendon | 15.2 (5.7 to 21.7) | 13.6 (0.6 to 23.6) | 30.2 (9.1 to 41.9) |
| Muscle injuries | 7.7 (3.2 to 10.4) | 4.7 (0.0 to 9.5) | 8.9 (0.0 to 23.7) |
| Achilles tendon injuries | 1.5 (0.0 to 4.0) | 0.6 (0.0 to 3.6) | 0.0 (0.0 to 15.8) |
| Ankle | 16.2 (11.2 to 29.2) | 9.5 (6.8 to 12.0) | 46.9 (26.5 to 130.0) |
| Ligament injuries | 11.0 (8.9 to 20.1) | 9.0 (4.3 to 11.5) | 38.1 (22.6 to 63.8) |
| Lateral ligaments | 7.9 (4.3 to 13.1) | 3.8 (2.2 to 6.9) | 12.6 (4.5 to 52.3) |
| Foot/toe | 9.0 (1.2 to 11.3) | 7.2 (0.8 to 10.5) | 3.2 (0.0 to 43.1) |

Injury burden is defined as the number of days lost per 1000 hours.

mechanism during training (48%, 14/29). Every sixth concussion was a recurrence (15%, 7/47) with four being early recurrences.

## DISCUSSION

The most important findings were that a typical 23-player squad could expect 35 time-loss injuries per season with a nearly fourfold higher incidence and a fivefold higher burden during match play compared with training. Muscle injuries dominated the injury landscape with hamstring and quadriceps muscle injuries being almost as frequent; however, ACL injury had the highest injury burden.

### Match injuries dominate the landscape

The match injury incidence and burden were significantly higher compared with training in general and for relevant injury subtypes such as hamstring muscle injuries, quadriceps muscle injuries, ACL injuries and concussions. We found, however, no difference in injury incidence between national team matches and club team matches which stands in contrast to findings in one systematic review that reported higher incidence in national team matches (55.7 vs 19.5 injuries per 1000 hours).[6] One possible explanation could be that we only included national team events from July to May, while off-season tournaments such as the Women's World Cup, Women's European Championship or the Olympic Games were not included.

### Hamstring muscle injury is most frequent

We found hamstring muscle injury to be the most frequent, representing 12% of all injuries. Similar results have been reported in women's football from Scandinavia,[10 16] but a Spanish one-club study reported quadriceps muscle injuries to be more frequent.[15] Interestingly, the number of quadriceps muscle injuries was only marginally lower in our dataset representing 11% of all injuries. Both these numbers contradict results in recent systematic reviews showing that ankle and knee injuries historically have been most frequent.[3 5] It is, therefore, likely that there is a similar trend as seen in men's professional football with a higher playing intensity over time,[26] and an accompanying shift from ligament injuries to muscle injuries.[18]

### ACL injury has the highest injury burden

We observed that 3% of all injuries affected the MCL of the knee with 72% being contact related. There are no previous data reported for MCL injury mechanisms in women's football, but this finding is in line with a study on male professional players, which reported the same percentage of MCL injury (3%) and almost the same percentage of contact-related injury mechanisms (75%).[27] Noteworthy, ACL injury was almost as frequent as MCL injury representing 2% of all injuries. This percentage, and the average rate of 0.7 ACL injuries per team and season, is identical to that previously reported for Swedish elite women players during the first decade of the 2000s.[28] Although the injury frequency was identical, the current study showed an average

**Table 5** Injury characteristics and severity for all four seasons (2018/2019 to 2021/2022)

| | Total | Slight (0 days) | Minimal (1–3 days) | Mild (4–7 days) | Moderate (8–28 days) | Severe (>28 days) |
|---|---|---|---|---|---|---|
| Injury | N | N (%) | N (%) | N (%) | N (%) | N (%) |
| Head/face | 60 | 4 (7) | 5 (8) | 14 (23) | 29 (48) | 8 (13) |
| Concussion | 47 | – | 3 (6) | 11 (23) | 25 (53) | 8 (17) |
| Neck/cervical spine | 11 | 1 (9) | 1 (9) | 6 (55) | 2 (18) | 1 (9) |
| Shoulder/clavicle | 24 | 2 (8) | 3 (13) | 2 (8) | 8 (33) | 9 (38) |
| Arm/hand | 37 | 3 (8) | 7 (19) | 5 (14) | 11 (30) | 11 (30) |
| Sternum/upper back | 8 | 1 (13) | 2 (25) | 3 (38) | 2 (25) | – |
| Abdomen | 7 | – | 2 (29) | 1 (14) | 4 (57) | – |
| Lower back/pelvis/ sacrum | 76 | 8 (11) | 22 (29) | 18 (24) | 21 (28) | 7 (9) |
| Hip/groin | 151 | 6 (4) | 43 (29) | 39 (26) | 53 (35) | 10 (7) |
| Muscle injuries | 104 | 4 (4) | 30 (29) | 27 (26) | 41 (39) | 2 (2) |
| Adductor | 66 | 3 (5) | 14 (21) | 18 (27) | 29 (44) | 2 (3) |
| Thigh | 408 | 21 (5) | 64 (16) | 98 (24) | 164 (40) | 61 (15) |
| Muscle injuries | 361 | 17 (5) | 57 (16) | 84 (23) | 150 (42) | 53 (15) |
| Quadriceps | 171 | 10 (6) | 29 (17) | 38 (22) | 66 (39) | 28 (16) |
| Hamstrings | 188 | 7 (4) | 28 (15) | 46 (25) | 82 (44) | 25 (13) |
| Knee | 270 | 8 (3) | 39 (14) | 45 (17) | 67 (25) | 111 (41) |
| Ligament injuries | 107 | 1 (<1) | 11 (10) | 14 (13) | 21 (20) | 60 (56) |
| Medial collateral | 43 | – | 4 (9) | 8 (19) | 15 (35) | 16 (37) |
| Anterior cruciate | 33 | – | – | – | – | 33 (100) |
| Meniscus/cartilage injuries | 56 | 2 (4) | 6 (11) | – | 17 (30) | 31 (55) |
| Lower leg/Achilles tendon | 175 | 9 (5) | 17 (10) | 46 (26) | 65 (37) | 38 (22) |
| Muscle injuries | 91 | 3 (3) | 7 (8) | 22 (24) | 41 (45) | 18 (20) |
| Achilles tendon injuries | 43 | 1 (2) | 6 (14) | 11 (26) | 17 (40) | 8 (19) |
| Ankle | 209 | 6 (3) | 32 (15) | 50 (24) | 78 (37) | 43 (21) |
| Ligament injuries | 156 | 2 (1) | 21 (14) | 37 (24) | 62 (40) | 34 (22) |
| Lateral ligaments | 111 | 2 (2) | 17 (15) | 25 (23) | 46 (41) | 21 (19) |
| Foot/toe | 91 | 4 (4) | 22 (24) | 18 (20) | 25 (28) | 22 (24) |

days loss of approximately 9 months, which is higher than in the aforementioned study from Sweden (almost 7 months) and in a study from the same period of German women elite players (6 months).[11 29] Given the high frequency of subsequent ACL injuries in women football players,[29 30] ACL-reconstructed players would benefit from the currently recommended approach 'better safe than quick' with a minimum time of 9 months before medical clearance has been suggested to decrease subsequent knee injuries following ACL reconstruction.[31 32]

## Do concussions need particular attention?

Our study showed that a women's elite team can expect one concussion every season on average. With a paucity of similar data on women football players, this finding is more than double the 0.4 concussions per team and season reported for male professional players.[33] This comparison should, however, be interpreted with caution due to possible between-sex differences in reporting thresholds and the possibility of increased awareness of concussive symptoms. Nevertheless, more than one-quarter of concussed players returned to play within 6 days after injury, which is similar to the aforementioned study of male players,[33] and earlier than recommended in the latest sports concussion consensus statements.[34] Of particular note was the finding that more than half of the concussions were due to ball-related impact (intentional heading or being hit accidentally by the ball). This suggests that the discussion around ball size, inflation pressure and mass in women's football might need to be revisited.[35]

## Perspectives on gradual onset and slight injuries

The occurrence of gradual onset injuries (47%) was almost twice that reported in the recent study of the Irish Women's National League (24%),[9] and also higher than older studies which defined these injuries as overuse or chronic (16%–28%).[8 11–14] The most plausible explanation is the aforementioned shift from, for example, contusions and ligament injuries to muscle injuries at the very top level. This shift in the injury landscape also likely explains that as many as 72% of all injuries were non-contact in nature.

We also found that slight injuries (0 days lost) were more frequent than the 2% found in a recent systematic review.[6] Importantly, slight injuries might be under-reported with a time-loss injury definition in youth or amateur football but should be negligible with the almost daily scheduled activities in women's professional football at this level although some between-club differences in reporting seem to exist.

## Research/policy implications

Previous literature on women's football is scarce. Our study extends the knowledge and understanding of injury epidemiology among women's elite football players and opens opportunities for further research. Our findings underline the importance of further research and implementation of preventive measures at all stakeholder levels for frequent injuries such as thigh muscle injuries, but also for injuries with high injury burden and possible negative long-term consequences such as ACL injury and concussion.

## Limitations

First, although the methodology was identical to the ECIS,[20] this does not guarantee identical reporting standards. Second, the methodology adhered to the guidelines of the original consensus statement for football,[21] but since the WECIS was launched before the IOC consensus statement and its recent football-specific consensus extension,[22 23] data could not retrospectively be fully arranged according to these recommendations such as the data in online supplemental table 2 and the reporting of football actions for sudden onset injuries which are missing. Third, it was beyond the scope to compare the findings with studies on men's professional football other than the ECIS, and we have mainly focused on comparisons with previous literature on women's football where possible. It would, however, be valuable in carrying out a 'head-to-head' comparison between the ECIS and the WECIS for clubs participating in both studies which should be addressed in the future. Fourth, there was minor data loss for mandatory information such as injury mechanisms, but some optional information such as specifying detailed muscle involvement were missing and will be upgraded to mandatory information from 2023/2024 as per most recent guidelines.[22 23] Fifth, in the interest of brevity, no in-depth analyses on potential differences in injury incidence and injury burden between the 'COVID-19' season 2019/2020 with the other three seasons were carried out as has been done for the ECIS recently.[36] Nevertheless, the 2019/2020 season had a significantly lower training injury incidence than the 2021/2022 season and a significantly lower match injury incidence than all the other three seasons.

## CONCLUSION

This study shows that an elite women's team squad can expect approximately 35 time-loss injuries per season with thigh muscle injury being most common and ACL injury most burdensome.

**Twitter** Anna Hallén @AnnaAnnhal, Rita Tomás @rtomasmd, Jan Ekstrand @JanEkstrand, Håkan Bengtsson @HockanB, Elke Van den Steen @Elkevandensteen, Martin Hägglund @MHgglund and Markus Waldén @MarkusWalden

**Acknowledgements** The authors would like to thank the participating teams with contact persons (online supplementary table 4), staff and players for their participation. The help of Michael Davison for general advice and language correction is greatly appreciated. The Football Research Group has been established in Linköping, Sweden, in collaboration with Linköping University and through grants from the Union of European Football Associations, the Swedish Football Association, and the Swedish National Centre for Research in Sports.

**Contributors** AH, RT, EVdS, JE and HB were responsible for the idea and conception of the study which was checked with MH and MW. AH collected all data with the help of MW for data on ACL injuries. AH and HB conducted the analyses which were planned and checked with JE, MH and MW. AH wrote the first draft of the paper which was critically revised by by all authors. All authors contributed to the interpretation of findings. The final manuscript has been approved by all authors. JE is the study guarantor.

**Funding** This study was funded by grants from the UEFA.

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** The study was approved by the by the Swedish Ethical Review Authority, Sweden (Ref no 2019-02727), UEFA Football Development Division and the UEFA Medical Committee. Participants gave informed consent to participate in the study before taking part.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request. All data relevant to the study are included in the article or uploaded as supplementary information.



**ORCID iDs**
Anna Hallén http://orcid.org/0000-0002-0478-8603
Jan Ekstrand http://orcid.org/0000-0002-6092-266X
Håkan Bengtsson http://orcid.org/0000-0003-3809-5909
Martin Hägglund http://orcid.org/0000-0002-6883-1471
Markus Waldén http://orcid.org/0000-0002-6790-4042

## REFERENCES

1 UEFA. Women's football across the National Associations 2017. Available: 2516057_DOWNLOAD.pdf (uefa.com) [Accessed 5 Dec 2022].
2 Alahmad TA, Kearney P, Cahalan R. Injury in elite women's soccer: a systematic review. *Phys Sportsmed* 2020;48:259–65.
3 Horan D, Büttner F, Blake C, *et al*. Injury incidence rates in women's football: a systematic review and meta-analysis of prospective injury surveillance studies. *Br J Sports Med* 2023;57:471–80.
4 Kirkendall DT, Krustrup P. Studying professional and recreational female footballers: a bibliometric exercise. *Scand J Med Sci Sports* 2022;32 Suppl 1:12–26.
5 López-Valenciano A, Raya-González J, Garcia-Gómez JA, *et al*. Injury profile in women's football: a systematic review and meta-analysis. *Sports Med* 2021;51:423–42.
6 Mayhew L, Johnson MI, Francis P, *et al*. Incidence of injury in adult elite women's football: a systematic review and meta-analysis. *BMJ Open Sport Exerc Med* 2021;7:e001094.
7 Okholm Kryger K, Wang A, Mehta R, *et al*. Research on women's football: a scoping review. *Sci Med Footb* 2022;6:549–58.
8 Engström B, Johansson C, Törnkvist H. Soccer injuries among elite female players. *Am J Sports Med* 1991;19:372–5.
9 Horan D, Blake C, Hägglund M, *et al*. Injuries in elite-level women's football – a two-year prospective study in the Irish Women's National League. *Scand J Med Sci Sports* 2022;32:177–90.
10 Hägglund M, Waldén M, Ekstrand J. Injuries among male and female elite football players. *Scand J Med Sci Sports* 2009;19:819–27.
11 Faude O, Junge A, Kindermann W, *et al*. Injuries in female soccer players: a prospective study in the German National League. *Am J Sports Med* 2005;33:1694–700.
12 Gaulrapp H, Becker A, Walther M, *et al*. Injuries in women's soccer: a 1-year all players prospective field study of the women's Bundesliga (German Premier League). *Clin J Sport Med* 2010;20:264–71.
13 Giza E, Mithöfer K, Farrell L, *et al*. Injuries in women's professional soccer. *Br J Sports Med* 2005;39:212–6.
14 Jacobson I, Tegner Y. Injuries among Swedish female elite football players: a prospective population study. *Scand J Med Sci Sports* 2007;17:84–91.
15 Larruskain J, Lekue JA, Diaz N, *et al*. A comparison of injuries in elite male and female football players: a five-season prospective study. *Scand J Med Sci Sports* 2018;28:237–45.
16 Nilstad A, Andersen TE, Bahr R, *et al*. Risk factors for lower extremity injuries in elite female soccer players. *Am J Sports Med* 2014;42:940–8.
17 Tegnander A, Olsen OE, Moholdt TT, *et al*. Injuries in Norwegian female elite soccer: a prospective one-season cohort study. *Knee Surg Sports Traumatol Arthrosc* 2008;16:194–8.
18 Ekstrand J, Spreco A, Bengtsson H, *et al*. Injury rates decreased in men's professional football: an 18-year prospective cohort study of almost 12 000 injuries sustained during 1.8 million hours of play. *Br J Sports Med* 2021;55:1084–91.
19 Waldén M, Hägglund M, Ekstrand J. UEFA Champions League study: a prospective study of injuries in professional football during the 2001–2002 season. *Br J Sports Med* 2005;39:542–6.
20 Hägglund M, Waldén M, Bahr R, *et al*. Methods for epidemiological study of injuries to professional football players: developing the UEFA model. *Br J Sports Med* 2005;39:340–6.
21 Fuller CW, Ekstrand J, Junge A, *et al*. Consensus statement on injury definitions and data collection procedures in studies of football (soccer) injuries. *Br J Sports Med* 2006;40:193–201.

22 Bahr R, Clarsen B, Derman W, *et al*. International Olympic Committee consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport 2020 (including STROBE extension for sport injury and illness surveillance (STROBE-SIIS)). *Br J Sports Med* 2020;54:372–89.
23 Waldén M, Mountjoy M, McCall A, *et al*. Football-specific extension of the IOC consensus statement: methods for recording and reporting of epidemiological data on injury and illness in sport 2020. *Br J Sports Med* 2023;57:1341–50.
24 Fuller CW. Injury risk (burden), risk matrices and risk contours in team sports: a review of principles, practices and problems. *Sports Med* 2018;48:1597–606.
25 Mansournia MA, Collins GS, Nielsen RO, *et al*. A checklist for statistical assessment of medical papers (the CHAMP statement): explanation and elaboration. *Br J Sports Med* 2021;55:1009–17.
26 Barnes C, Archer DT, Hogg B, *et al*. The evolution of physical and technical performance parameters in the English Premier League. *Int J Sports Med* 2014;35:1095–100.
27 Lundblad M, Hägglund M, Thomeé C, *et al*. Medial collateral ligament injuries of the knee in male professional football players: a prospective three-season study of 130 cases from the UEFA Elite Club Injury Study. *Knee Surg Sports Traumatol Arthrosc* 2019;27:3692–8.
28 Waldén M, Hägglund M, Magnusson H, *et al*. Anterior cruciate ligament injury in elite football: a prospective three-cohort study. *Knee Surg Sports Traumatol Arthrosc* 2011;19:11–9.
29 Allen MM, Pareek A, Krych AJ, *et al*. Are female soccer players at an increased risk of second anterior cruciate ligament injury compared with their athletic peers *Am J Sports Med* 2016;44:2492–8.
30 Britt E, Ouillette R, Edmonds E, *et al*. The challenges of treating female soccer players with ACL injuries: hamstring versus bone-patellar tendon-bone autograft. *Orthop J Sports Med* 2020;8:2325967120964884.
31 Fältström A, Kvist J, Hägglund M. High risk of new knee injuries in female soccer players after primary ACL reconstruction after 5- to 10-years follow-up. *Am J Sports Med* 2021;49:3479–87.
32 Grindem H, Snyder-Mackler L, Moksnes H, *et al*. Simple decision rules can reduce reinjury risk by 84% after ACL reconstruction: the Delaware-Oslo ACL cohort study. *Br J Sports Med* 2016;50:804–8.
33 Nilsson M, Hägglund M, Ekstrand J, *et al*. Head and neck injuries in professional soccer. *Clin J Sport Med* 2013;23:255–60.
34 Schneider KJ, Patricios J, Echemendia RJ, *et al*. Concussion in sport: the consensus process continues. *Br J Sports Med* 2022;56:1059–60.
35 Auger J, Markel J, Pecoski DD, *et al*. Factors affecting peak impact force during soccer Headers and implications for the mitigation of head injuries. *PLoS ONE* 2020;15:e0240162.
36 Waldén M, Ekstrand J, Hägglund M, *et al*. Influence of the COVID-19 lockdown and restart on the injury incidence and injury burden in men's professional football leagues in 2020: the UEFA Elite Club Injury Study. *Sports Med Open* 2022;8:67.